

STANDARD 5: MEASUREMENT AND DISCRETE MATHEMATICS

Students make and use direct and indirect measurement, metric and U.S. customary, to describe and compare the real world and to prepare for the study of discrete functions, fractals and chaos which have evolved out of the age of technology.

READINESS (Kindergarten)

Students know and are able to do the following:

- **5M-R1. Recognize that a single object has different attributes (e.g., length, color, size, texture) that can be measured in different ways**
- **5M-R2. Compare and order objects according to observable attributes**
- **5M-R3. Use a variety of puzzles and games involving counting problems**

FOUNDATIONS (Grades 1-3)

Students know and are able to do all of the above and the following:

- **5M-F1. Demonstrate that a single object has different attributes that can be measured in different ways (e.g., length, mass/weight, time, temperature, area and volume)**

PO 1. Determine the characteristics (attributes) of an object that are measurable (e.g., length and weight are measurable; color and texture are not measurable)

PO 2. Identify the type of measure (e.g., weight, height, volume) for each attribute

- **5M-F2. Explain the concepts related to units of measure and demonstrate the process of measurement with non-standard (e.g., using paper clip lengths), U.S. customary and metric units**

PO 1. Select the appropriate unit of measure for a given characteristic of an object
length - inches, feet and yards;

centimeters and meters

capacity/volume - cups, gallons and liters

mass/weight - ounces, pounds, grams
and kilograms

PO 2. Select the appropriate tool to measure the given characteristic of an object (e.g., ruler, thermometer, measuring cup, scale)

PO 3. Measure a given characteristic of an object using non-standard units of measure

PO 4. Measure a given characteristic of an object using standard units of measure

- PO 5. Tell time to the nearest minute on digital and traditional (analog) clocks
- PO 6. Determine the passage of time (i.e., units of days, months and years) using a calendar
- PO 7. Compare units of measure to determine *more* or *less* relationships
- | | |
|------------|---|
| length - | inches and feet
feet and yards
centimeters and meters |
| capacity - | cups and gallons |
| mass - | ounces and pounds
grams and kilograms |
| time - | minutes and hours
hours and days
days and weeks
months and years |
| money - | pennies, nickels, dimes,
quarters and dollars |
- PO 8. Compare units of measure to determine equivalent relationships
- | | |
|----------|--|
| length - | inches to feet |
| time - | minutes to hours
days to weeks
months to years |
| money - | pennies, nickels, dimes,
quarters to dollars |
- PO 9. Read a thermometer in Celsius and Fahrenheit to the nearest degree

- **5M-F3. Make estimates of measurement**

- PO 1. Estimate a measurement
- PO 2. Compare the estimation to actual measure
- PO 3. Evaluate the reasonableness of the estimation

- **5M-F4. Use discrete mathematical models for graphs to represent everyday situations (e.g., determine how many ways to move from point A to point B on a grid)**

- PO 1. Make a diagram to represent the number of combinations between two sets (e.g., “How many outfits can one make with three different colors of shirts and two different pairs of pants?”)

ESSENTIALS (Grades 4-8)

Students know and are able to do all of the above and the following:

- **5M-E1. Estimate, make and use measurements (U.S. customary and metric) to describe and make comparisons**

(Grades 4-5)

- PO 1. Measure length, volume and weight in both U.S. customary and metric units
- PO 2. Convert measurement units to equivalent units **within** a given system (customary and metric) (e.g., 12 inches = 1 foot, 10 decimeters = 1 meter)
- PO 3. Estimate measurements for both U.S. customary and metric units within either system

(Grades 6-8)

- PO 3. Estimate measurements for both U.S. customary and metric units within either system
- PO 4. Compare estimated measurements **between** U.S. customary and metric systems (e.g., a yard is about a meter)

- **5M-E2. Select and use appropriate units and tools to measure to the degree of accuracy required in a particular problem-solving situation**

(Grades 4-5)

- PO 1. State the appropriate tool to measure in a particular situation (e.g., “What tool would you use to measure the top of your desk?”)
- PO 2. State the appropriate unit of measurement in a particular situation (e.g., “What unit of measurement would you use to measure the top of your desk?”)
- PO 3. Measure to the appropriate degree of accuracy to solve problems (e.g., measuring to the nearest sixteenth of an inch or using ounces, measuring to the nearest millimeter or using liters)

(Grades 6-8)

- PO 3. Measure to the appropriate degree of accuracy to solve problems (e.g., measuring to the nearest sixteenth of an inch or using ounces, measuring to the nearest millimeter or using liters)

- **5M-E3. Estimate, use and describe measures of distance, perimeter, area, volume, capacity, weight, mass and angles**

(Grades 4-5)

- PO 1. Differentiate between perimeter and area of quadrilaterals using concrete and illustrative models
- PO 2. Record estimates and measurements for
 - A. distance
 - A. perimeter
 - E. area
 - G. weight

(Grades 6-8)

- PO 2. Record estimates and measurements for
 - B. distance in scale drawings
 - B. circumference
 - C. area
 - F. volume
 - H. mass
 - I. degrees of angles
 - J. capacity
- PO 3. Compare weight to mass and capacity to volume

- **5M-E4. Develop and use formulas and procedures to solve problems involving measurement**

(Grades 4-5)

- PO 1. Develop a procedure or formula to calculate
 - A. area and perimeter of simple polygons
- PO 2. Use **given** formulas to find
 - A. area and perimeter of simple polygons

(Grades 6-8)

- PO 1. Develop a procedure or formula to calculate
 - B. area of polygons and circles
 - C. surface area of rectangular prisms
 - D. volume of rectangular prisms
- PO 2. Use **given** formulas to find
 - B. circumference of a circle
 - C. area of polygons and circles
 - D. surface area of rectangular prisms
 - E. volume of prisms

- **5M-E5. Describe how a change in the linear dimension of an object affects its perimeter, area and volume**

(Grades 4-5)

PO 1. Describe the change in perimeter and area when one dimension of an object is altered

(Grades 6-8)

PO 2. Describe the effect on perimeter, area and volume when one dimension of an object is altered

- **5M-E6. Use calculators and computers to perform basic recursive and iterative processes**

(Grades 4-5)

PO 1. Solve a problem using the iterative process

A. doubling (e.g., “If you get paid 1 cent the first day, 2 cents the second day, each day doubling the previous day’s pay, how much would you get paid on the twentieth day?”)

PO 2. Generate the iterative sequence for the next six terms when given the first four terms (e.g., 4, 7, 10, 13, . . .)

(Grades 6-8)

PO 1. Solve a problem using the iterative process

B. designing a simple geometric pattern (e.g., design a basic quilt block; use it to generate the whole quilt)

PO 3. Complete the iterative sequence (e.g., given these terms and assuming a constant difference 21, -, -, -, -, 63, -, -, -)

PO 4. Generate subsequent terms of a recursive sequence (e.g., 3, 3, 6, 9, 15, . . .)

PROFICIENCY (Grades 9-12)

Students know and are able to do all of the above and the following:

- **5M-P1. Represent problem situations using discrete structures such as finite graphs, matrices, sequences and recurrence relations**

Beyond Core*

PO 1. Use matrices and finite graphs to display data

PO 2. Find a specified n^{th} term of a simple arithmetic or geometric sequence, where the common difference or common ratio is an integer and $n > 100$

PO 3. Use simple or basic recursion formulas to solve real-life problems (e.g., compound interest)

- **5M-P2. Represent and analyze finite graphs using matrices**

Beyond Core

- PO 1. Interpret data using matrices and finite graphs (e.g., networks, street diagrams, tournament schedules, production schedules)
- PO 2. Determine when a finite graph gives an accurate picture of a data set
- PO 3. Translate a finite graph into a matrix and vice versa

- **5M-P3. Develop and analyze algorithms**

Core – will be tested on AIMS

- PO 2. Determine the purpose of a given algorithm (simple, basic **math** algorithm)
- PO 3. Determine whether given algorithms are equivalent (simple, basic **math** algorithms)

Core – to be taught in grades 9-10, but will not be tested on AIMS

- PO 1. Write an algorithm that explains a particular mathematical process (e.g., tell a younger child how to find the average of two numbers)

- **5M-P4. Solve enumeration and finite probability problems**

Core – will be tested on AIMS

- PO 1. Find the outcome set of a situation
- PO 2. Find the probability that a specific event will happen
- PO 4. Determine the number of possible outcomes in a real-world situation using the counting principle and tree diagrams

Core – to be taught in grades 9-10, but will not be tested on AIMS

- PO 3. Determine theoretical geometrical probabilities, given necessary formulas (e.g., “Given a circular target on a square base, what is the probability of hitting the circle with a dart, providing the dart goes inside the square?”)
- {PO 5 Deleted}

*Beyond Core: Appropriate to be taught after a grounding in core instruction, but will not be tested on AIMS

DISTINCTION (Honors)

Students know and are able to do all of the above and the following:

- **5M-D1. Represent and solve problems using linear programming and difference equations**
- **5M-D2. Investigate problem situations that arise in connection with computer validation and the application of algorithms**
- **5M-D3. Describe, analyze and extend patterns produced by processes of geometric change such as fractals**

